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Specific features of thermal and magnetic properties of Yb B50 at low temperatures

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Abstract

© 2018 American Physical Society. Heat capacity, thermal expansion, and magnetization of ytterbium boride YbB50 were studied at temperatures 0.6-300 K, 5-300 K, and 2-300 K, respectively. We revealed two smooth peaks at about 4.0 and 60 K in the temperature dependence of the heat capacity. A comparison with the heat capacity of the diamagnetic isostructural boride LuB50 shows that these anomalies can be attributed to excitations in the ytterbium sublattice (Schottky anomalies). A scheme for splitting of the ground F7/22 multiplet of Yb3+ ions in the crystal field is proposed. Reliability of the proposed crystal-field energies of the Yb3+ ions is confirmed by the analysis of temperature dependencies of magnetic susceptibility and magnetization in applied magnetic fields up to 55 kOe. A clear anisotropy of the thermal expansion and a negative expansion within a wide temperature range (40-185 K) were observed. Assuming that this anomaly of the thermal expansion in higher borides is caused by the specific thermal evolution of a crystal lattice observed earlier, in particular, in LuB50, and the interaction of rare-earth ions with lattice strains, we have determined phenomenological Grüneisen parameters which characterize effects due to thermal transitions of Yb3+ ions between the ground and excited states. A phase transition of YbB50 to any magnetically ordered state was not observed down to the lowest temperatures of experiments.

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